REMARKS

Claims 1, 2, 4-9, 17-22, 26-29, and 31-37 are pending in the present application. Reconsideration and allowance of pending claims 1, 2, 4-9, 17-22, 26-29, and 31-37 in view of the following remarks are requested.

In the Office Action dated November 17, 2004, the Examiner has ***finally rejected*** claims 1, 2, 4-9, 17-22, 26-29, and 31-37 pending in the present application on the basis of new ground(s) of rejection and newly cited art. Applicant respectfully requests reconsideration and withdrawal of the finality of the rejection of the Office Action dated November 17, 2004.

A good and sufficient reason why the present response is necessary and was not earlier presented is that an entirely new reference has been cited in the present final rejection dated November 17, 2004 (37 CFR §1.116(c)). The new reference is Toru Yamazaki (USPN 5,880,516) (hereinafter "Yamazaki"), which is for the first time brought to Applicant's attention by means of the present ***final rejection*** dated November 17, 2004. The new reference, i.e. Yamazaki, was not cited in the present application prior to the instant final rejection. Since Yamazaki is a new reference, and indeed the primary reference, upon which the Examiner has now relied, Applicant believes that it would be manifestly unfair for the Patent Office not to consider Applicant's arguments, which are necessitated due to the newly cited reference, Yamazaki.

A. **Rejection of Claims 1-2, 6, 9, 17-18, 20-21, 26-28, 29, 33, and 35-37 under 35 USC §103(a)**

The Examiner has rejected claims 1-2, 6, 9, 17-18, 20-21, 26-28, 29, 33, and 35-37 under 35 USC §103(a) as being unpatentable over Yamazaki. For the reasons discussed below, Applicant respectfully submits that the present invention, as defined by independent claims 1, 9, 26, and 35, is patentably distinguishable over Yamazaki.

The present invention, as defined by independent claims 1 and 26, includes, among other things, selecting a first peak dopant concentration and a first implant energy such that at least one of capacitance, leakage current, and tuning range of a varactor device is optimized, forming a first implant in an epitaxial layer using the first implant energy, where the first implant has the first peak dopant concentration, and forming a second implant in the epitaxial layer using a second implant energy, where the second implant has a second peak dopant concentration, and where the second implant extends into the epitaxial layer a greater distance than the first implant. As disclosed in the present application, the present invention provides a method of fabricating a varactor diode having low leakage current, high tuning range, and a high quality factor (Q) by utilizing an innovative double-implant process.

As disclosed in the present application, first and second implants are formed in an epitaxial layer in an implant region of a semiconductor substrate, where the first and second implants have first and second peak dopant concentrations and first and second implant energies, respectively. As disclosed in the present application, the first implant is

a shallow implant while the second implant is a deep implant that is formed below the first shallow implant. As disclosed in the present application, by appropriately selecting the first peak dopant concentration and first implant energy of the first implant, the present invention advantageously achieves a double-implant varactor device having at least an optimized capacitance, leakage current, or tuning range.

Also, as disclosed in the present application, by appropriately selecting the second peak dopant concentration and appropriately selecting the second implant energy such that the second implant is disposed below the first implant, the present invention achieves a double-implant varactor having a minimized base resistance. By minimizing base resistance, the present invention advantageously achieves a varactor having an optimized Q. Thus, by appropriately choosing the first and second peak dopant concentrations and first and second implant energies of respective first and second implants, the present invention advantageously achieves a double-implant varactor that can be selectively optimized to meet the specific requirements of a particular application. Thus, present invention advantageous achieves a varactor wherein all of the varactor's parameters, i.e. capacitance, leakage current, tuning range, and base resistance, can be advantageously optimized by appropriately selecting the first and second peak dopant concentrations and first and second implant energies of first and second implants, respectively.

In contrast, Yamazaki does not teach, disclose, or suggest selecting a first peak dopant concentration and a first implant energy such that at least one of capacitance, leakage current, and tuning range of a varactor device is optimized, forming a first

implant in an epitaxial layer using the first implant energy, where the first implant has the first peak dopant concentration, and forming a second implant in the epitaxial layer using a second implant energy, where the second implant has a second peak dopant concentration, and where the second implant extends into the epitaxial layer a greater distance than the first implant. Yamazaki is directed to improving the operation speed of a bipolar transistor in a low-current injection region to a high-current injection while suppressing the Kirk effect. Yamazaki specifically discloses sequentially forming first, second, and third n-type pedestal collector regions 102, 103, and 104 in n-type epitaxial layer 3 immediately below emitter region 12. See, for example, column 5, lines 16-19 and Figure 3 of Yamazaki.

In Yamazaki, pedestal collector regions 102, 103, and 104 are formed such that their impurity concentrations and areas increase toward the inner portion of the substrate (as the depth is increased). See, for example, Yamazaki, column 6, lines 31-36. In Yamazaki, pedestal collector regions 102, 103, and 104 are formed to suppress the Kirk effect without increasing base-collector parasitic capacitance without degrading the cut-off frequency. See, for example, Yamazaki, column 6, lines 36-39. However, Yamazaki fails to teach, disclose, or suggest selecting a first peak dopant concentration and a first implant energy such that at least one of capacitance, leakage current, and tuning range of a varactor device is optimized, as specified in independent claims 1 and 26. In Yamazaki, as discussed above, all three pedestal collector regions (i.e. pedestal collector regions 102, 103, and 104) are formed as a group to suppress the Kirk effect in a bipolar transistor

without increasing base-collector parasitic capacitance. Furthermore, Yamazaki does not even mention a varactor device, much less optimizing a varactor device.

Moreover, as recited independent claims 1 and 26, a first peak dopant concentration and a first implant energy are selected such that at least one of capacitance, leakage current, and tuning range of a varactor device is optimized prior to forming first and second implants. In contrast, Yamazaki fails to teach, disclose, or remotely suggest any optimization of selected parameters of a varactor device.

For the foregoing reasons, Applicant respectfully submits that the present invention, as defined by independent claims 1 and 26, is not suggested, disclosed, or taught by Yamazaki. As such, the present invention, as defined by independent claims 1 and 26, is patentably distinguishable over Yamazaki. Thus claims 2 and 6 depending from independent claim 1 and claims 27-28, 29, and 33 depending from independent claim 26 are, *a fortiori*, also patentably distinguishable over Yamazaki for at least the reasons presented above and also for additional limitations contained in each dependent claim.

Independent claims 9 and 35 recites similar limitations as independent claims 1 and 26. Additionally, independent claims 9 and 35 recite, among other things, selecting a second peak dopant concentration and a second implant energy with relation to a first peak dopant concentration and a first implant energy such that the base resistance of a varactor device is minimized. In contrast, Yamazaki fails to teach, disclose, or remotely suggest selecting a second peak dopant concentration and a second implant energy with

relation to a first peak dopant concentration and a first implant energy such that the base resistance of a varactor device is minimized. Thus, for at least the reasons discussed above, independent claims 9 and 35 are also patentably distinguishable over Yamazaki. Thus claims 17-18 and 20-21 depending from independent claim 9 and claims 36-37 are, *a fortiori*, also patentably distinguishable over Yamazaki for at least the reasons presented above and also for additional limitations contained in each dependent claim.

B. Rejection of Claims 4-5, 7-8, 31-32, and 34 under 35 USC §103(a)

The Examiner has rejected claims 4-5, 7-8, 31-32, and 34 under 35 USC §103(a) as being unpatentable over Yamazaki in view of IBM Corporation (NN79013241), "Determination of Doping Profiles by Means of SIMS," IMB Technical Disclosure Bulletin, 1979, Vol. 21, Issue Number 8, pp. 3241-3242. As discussed above, independent claims 1 and 26 are patentably distinguishable over Yamazaki. Thus claims 4-5 and 7-8 depending from independent claim 1 and claims 31-32 and 34 depending from independent claim 26 are, *a fortiori*, also patentably distinguishable over Yamazaki for at least the reasons presented above and also for additional limitations contained in each dependent claim.

C. Rejection of Claims 19 and 22 under 35 USC §103(a)

The Examiner has rejected claims 19 and 22 under 35 USC §103(a) as being unpatentable over Yamazaki in view of U.S. patent number 3,770,519 to Siegfried K.

Wiedmann. As discussed above, independent claim 9 is patentably distinguishable over Yamazaki. Thus claims 19 and 22 depending from independent claim 9 are, *a fortiori*, also patentably distinguishable over Yamazaki for at least the reasons presented above and also for additional limitations contained in each dependent claim.

D. Conclusion

Based on the foregoing reasons, the present invention, as defined by independent claims 1, 9, 26, and 35, and claims depending therefrom, is patentably distinguishable over the art cited by the Examiner. Thus, claims 1-2, 4-9, 17-22, 26-29, and 31-37 pending in the present application are patentably distinguishable over the art cited by the Examiner. As such, and for all the foregoing reasons, an early Notice of Allowance for claims 1-2, 4-9, 17-22, 26-29, and 31-37 pending in the present application is respectfully requested.

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Respectfully Submitted,
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